# SERVICE BULLETIN

**NUMBER:** SB-221-032
**DATE:** 12/4/03
**MODEL:** All

**(Not applicable to Mack Trucks Australia)**
**(Supersedes bulletin SB-221-032 dated 3/20/03)**

## 9-2 FAULT CODE DIAGNOSTICS AND REPAIR PROCEDURES

A 9-2 fault code “Power reset without Key Switch” (Failure Mode Identifier [FMI] 4, Parameter Identifier [PID] S254 and Message Identification [MID] 128/142), will set with a MID 142 if the Vehicle Electronic Control Unit (VECU) senses a loss of battery without the key switch being turned off. A 9-2 fault code will set with a MID 128 if the Engine Electronic Control Unit (EECU) senses a loss of switched power without the key switch being turned off. Fault code 9-2 generally indicates a loss of power or ground connection to the VECU or EECU. Complete electronic diagnostic procedures for troubleshooting a 9-2 fault code are outlined in the*V-MAC® III Service Manual,* 8-211 (dated October 2001 or later). In addition to the diagnostic procedures outlined in the V-MAC® III service manual, when troubleshooting the cause of a 9-2 fault code, the investigation should include the following:

**NOTE**

The following procedures cover all chassis equipped with MACK engines and CL and CV model chassis equipped with Cummins engines.

**NOTE**

To avoid a repeat failure, do not stop performing the procedures outlined in this bulletin at the point where it appears that the problem may have been corrected. All steps (steps 1 through 8), plus the voltage drop tests, must be performed to ensure that the cause of the 9-2 fault code has been repaired.

1. Inspect the batteries.
   a. Load test each battery.
   b. Check tightness of each battery connection. Clean and tighten as necessary.
   c. If the vehicle is equipped with a battery disconnect switch, check the connections for corrosion and tightness. Clean and tighten as necessary.
2. Inspect the battery cable connections at the starter motor.
   a. Before proceeding, disconnect the negative battery cables from the battery.
   b. Remove the positive and negative battery cables from the starter motor. Note the tightness of the cable connections while they are being removed.
   c. Note any corrosion on the cable ends, then clean both sides of the cable terminal.
   d. Reinstall the battery cables and tighten the retaining nuts to 270 lb-in (31 N·m).


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3. Inspect the left-side engine ground.
    a. Remove the bolt that secures the ground cable to the engine block (note the tightness of the ground bolt prior to removal). After removing the ground bolt, discard the star washer.
    b. Clean the ring terminals of all the ground wires, and also clean the ground bolt boss on the side of the engine block.
    c. Measure the length of the ground bolt, then measure the depth of the bolt hole in the engine block. Compare the measurements to be sure the bolt will not bottom in the bolt hole when tightened.
    d. Install the ground wire ring terminals onto the ground bolt, then install the bolt into the bolt hole in the engine block. Fan the ring terminals around the ground bolt so that the wire lugs are not on top of each other. Tighten the ground bolt to 120 lb-ft (163 N·m).

REV 4. Inspect the left-side frame ground.
    a. Remove the bolt that secures the ground cables and wires to the left-side frame rail (note the tightness of the bolt prior to removal). After removing the bolt, discard the star washer (if equipped).
    b. Inspect the bolt and the wire ring terminals for signs of arcing or corrosion.
    c. Clean both sides of the ring terminals, making sure to remove all traces of the heat shrink sealant that may have oozed out during the heat sealing process.
    d. Clean around the ground bolt hole on both sides of the frame rail.
    e. Install the ground bolt, ground cables and wires, flat washer and nut. Fan the ring terminals around the ground bolt so that the wire lugs are not on top of each other. Tighten the nut to 37.5 lb-ft (51 N·m).

**NOTE**

DO NOT use a star washer.

    f. Spray paint the area of the frame rail around the ground bolt to prevent rust from forming.
5. Inspect the ground circuit breaker.
    a. Remove the retaining nuts that secure the cables to the terminals of the ground circuit breaker (note the tightness of the nuts prior to removal).
    b. Discard the nuts with the captured star washers.
    c. Clean both sides of the ring terminals, being sure to remove all traces of heat shrink sealant that may have oozed out during the heat sealing process.
    d. Install the wire ring terminals onto the terminal stud on the ground circuit breaker. Install a new nylock nut (part No. 21AX938) onto the terminal. Fan the ring terminals around the terminal stud so that the wire lugs are not on top of each other. Tighten the nut to 65 lb-in (6.16 N·m).

6. Inspect the left-hand side dashboard ground wire.
    a. Remove the instrument cluster and note the tightness of the ground bolt.
    b. Remove the ground bolt, discard the star washer and clean all the ring terminals.
    c. Sand or scrape to remove the paint from around the ground bolt hole.
    d. Install a flat washer over the ground bolt, then insert the bolt through the cross bar from the front side. Install another flat washer and secure with a prevailing torque nut.
    e. Install a flat washer over the bolt, then install the ground wire ring terminals, a flat washer and secure with a prevailing torque nut. Tighten the nut to 108 lb-in (12 N·m).
7. Inspect the right-hand side dashboard ground.
    a. Remove the “D” panel from the dashboard, then check the tightness of the ground bolt.
    b. Remove the ground bolt, discard the star washer and clean all the ring terminals.
    c. Sand or scrape to remove the paint from around the ground bolt hole.
    d. Install a flat washer over the ground bolt, then insert the bolt through the cross bar from the front side. Install another flat washer and secure with a prevailing torque nut.
    e. Install a flat washer over the bolt, then install the ground wire ring terminals, a flat washer and secure with a prevailing torque nut. Tighten the nut to 108 lb-in (12 N·m).
8. If the 9-2 code is logged in the VECU, proceed as follows:
    a. Remove fuse or circuit breaker No. 16 from the electrical equipment panel.
    b. Insert the purple male test lead adapter included in the Kent-Moore V-MAC® Test Lead Adapter Kit (tool No. J 38581) into the female terminal to check the tightness of the terminal.
    c. If the drag felt on the test lead is not sufficient, replace the female terminal end (part No. 925AM173).
    d. Remove power relay Nos. 1 and 2 from the electrical equipment panel.
    e. Check the terminal blades of the relays for deep scratches which indicated good contact between the female terminals and the male terminal blades of the relays.
    f. If deep scratches are not present, inspect the female terminals for damage or spreading. Replace the female terminals as required (part Nos. 2967-2807554 [Amp Industries part No. 280755-4] and 2967-422811 [Amp Industries part No. 42281-1]).

**NOTE**

Although the power relays may seem tight when being removed from the electrical equipment panel, this does not indicate sufficient contact between the male and female terminals. The only way of determining sufficient contact is by looking for deep scratches on the male terminals.

9. If the 9-2 code is logged in the EECU, proceed as follows:
    a. Remove fuse or circuit breaker No. 40 from the Engine Power Distribution Module (EPDM).
    b. Insert the purple male test lead adapter included in the Kent-Moore V-MAC® Test Lead Adapter Kit (tool No. J 38581) into the female terminal to check tightness of the terminal.
    c. If the drag felt on the test lead is not sufficient, replace the female terminal end (part No. 6031-12110844).
    d. Disconnect connector “B” from the EPDM.
    e. Inspect the connector terminals for corrosion and other damage, and check to make sure that each terminal is fully seated and locked in the connector body.
    f. Disconnect the engine-to-transmission transition connector.
    g. Inspect the terminals for corrosion and other damage, and check to make sure that each terminal is fully seated and locked in the connector bodies.

**Testing Voltage Drop**

Measuring voltage drop across a cable or a cable connection is useful in determining the integrity of the circuit. Cables or connectors should have no measurable, or only a fractional voltage drop. For a wire, cable or connector, voltage drop should be 0.1 volt or less, and for an insulated or ground circuit, voltage drop should be 0.5 volt or less. Voltage drop measurements greater than 0.1 volt for a cable or connector indicate the presence of high resistance that could be caused by a loose connection, dirt or corrosion. When diagnosing a 9-2 fault code, the following voltage drop tests should be performed, and the information gathered from these tests should be recorded on the “Voltage Drop Test/Battery Load Test Results” form included at the end of this service bulletin. The completed form can then be faxed to the Mack Trucks Electronic Service Engineering Department for analysis.

**Voltage Drop Test Procedures**

Voltage drop is measured by placing a digital multimeter (volt-ohm meter) in parallel with the component (wire, connection, etc.) as follows:

1. Set the multimeter to the VDC function.
2. Turn the vehicle ignition switch to the ON position.

**SERVICE HINT**

Long jumper wires with alligator clips on both ends may be used to facilitate performing the following tests.

3. Measure voltage drop on the positive side of the battery by placing the positive meter lead on the positive battery post (terminal), then place the negative meter lead at the following test points:
    a. Battery positive post to battery positive cable end
    b. Battery positive post to starter solenoid battery (B) terminal
    c. Battery positive post to starter relay battery (B) terminal
    d. Battery positive post to power relays 1, 2, 3 and 4
    e. Battery positive post to alternator positive (B) terminal
4. Measure voltage drop on the negative side of the battery by placing the positive meter lead on the negative battery post (terminal), then place the negative meter lead at the following test points:
    a. Battery negative post to battery negative cable end
    b. Battery negative post to starter ground terminal
    c. Battery negative post to frame ground
    d. Battery negative post to master ground circuit breaker
    e. Battery negative post to left-hand side dashboard ground terminal
    f. Battery negative post to right-hand dashboard ground terminal
    g. Battery negative post to alternator ground (G) terminal
    h. Battery negative post to left-hand side engine ground connection
5. Record the voltage drop measurements obtained at the above locations in the form provided with this bulletin. If voltage drop measurements are higher than specified, clean the connectors, terminals, etc., as required and retest.

In addition to the above voltage drop tests, also perform an open circuit voltage test and load test of all the batteries. Include this information on the form provided with this bulletin.

**NOTE**

For information concerning voltage drop tests, battery open circuit voltage tests and battery load tests, refer to the *MACK Electrical Troubleshooting Manual,* 8-212.

**Multiplexing (MUX) Settings — CL and CV Model Chassis Equipped with Cummins Engines**

On CL and CV model chassis equipped with Cummins engines, the following multiplexing (MUX) settings must be verified. These settings must be verified by an authorized Cummins facility using INSITE™ software.

**Figure 1 — J1939 Multiplexing 1 Screen**

**Figure 2 — J1939 Multiplexing 2 Screen**

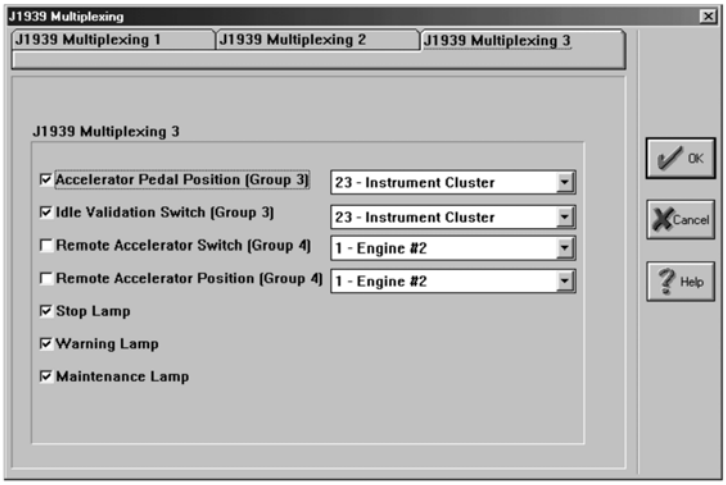


**Figure 3 — J1939 Multiplexing 3 Screen**

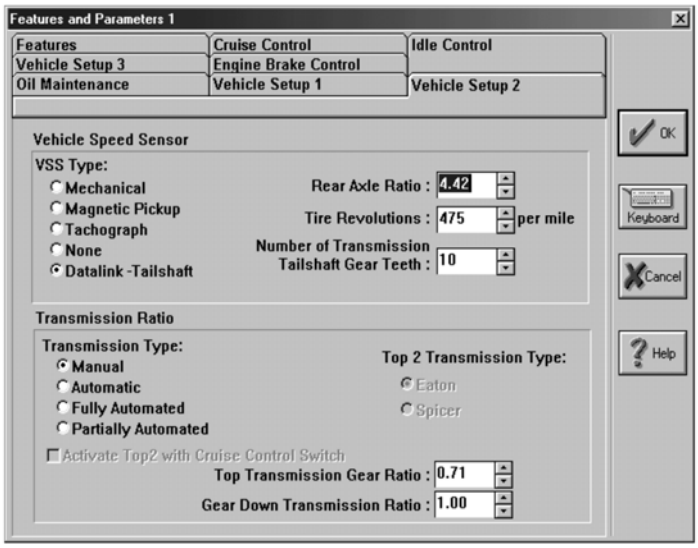


**Figure 4 — Features and Parameters Screen**

## Cummins Engine Codes

In chassis equipped with a Cummins engine, the engine control module (ECU) uses specific codes that identify it as an engine in a MACK chassis. The following table lists these specific codes. These codes can be viewed by an authorized Cummins facility using INSITE™ software.

| SC | Engine Model | DO | FR | (PP) CPL | AP | Torque | ECM code (ECM part No. 3681405) | ECM code (ECM part No. 3408426) | ECM code (ECM part No. 3408501) | |
|---|---|---|---|---|---|---|---|---|---|---|
| 10682 | ISX-530 | 1169 | 10409 | 2834 | 1034 | 1850 | N11341 | N11333 | N11337 | MACK |
| 10426 | ISX-565 | 1169 | 10515 | 2834 | 1034 | 1850 | N10358 | N10350 | N11251 | MACK |
| 10425 | ISX-600 | 1169 | 10311 | 2834 | 1034 | 1850 | N10357 | N10349 | N11249 | MACK |
| 10423 | Signature 600 STX | 1169 | 10296 | 2834 | 1034 | 2050 | N10356 | N10348 | N11246 | MACK |
| 10421 | Signature 600 | 1168 | 10149 | 2834 | 1034 | 2050 | N10355 | N10347 | N11244 | MACK |
| 10413 | ISX-500/1650 | 1168 | 10152 | 2629 | 1034 | 1650 | N11268 | N11231 | N11239 | MACK |
| 10412 | ISX-500/1850 | 1168 | 10192 | 2629 | 1034 | 1850 | N11267 | N11230 | N11238 | MACK |
| 10334 | ISX-500 ST2 | 1168 | 10079 | 2629 | 1034 | 1650 | N11266 | N11229 | N11237 | MACK |

**NOTE**

On CL and CV model chassis equipped with a Cummins engine, verify that the terminating resistor (part No. 598AX197) is installed at the ECM.

The labor code and maximum labor allowance for the procedures outlined in this bulletin are as follows:

| | | |
|---|---|---|
| 230 CA 2T 80 ..... | 3.5 hrs. — | Time allowed to perform diagnostic and repair procedures relating to a logged 9-2 fault code. |

# VOLTAGE DROP TEST/BATTERY LOAD TEST RESULTS

CHASSIS INFORMATION:

Model: _____ VIN: _____

Mileage: _____ Customer: _____

Dealer Code: _____ Contact Name: _____

FAX completed form to Vehicle Electronic Service Engineering at 610-709-3800

### Battery Positive Side Circuit Voltage Drop Test

| Measurement Points | First Measurement | Second Measurement |
|---|---|---|
| Battery positive post to battery positive cable end | | |
| Battery positive post to starter solenoid B terminal | | |
| Battery positive post to starter relay B terminal | | |
| Battery positive post to power relay No. 1 | | |
| Battery positive post to power relay No. 2 | | |
| Battery positive post to power relay No. 3 | | |
| Battery positive post to power relay No. 4 | | |
| Battery positive post to alternator B terminal | | |

First measurement taken before cleaning
Second measurement taken after cleaning

### Battery Negative Side Circuit Voltage Drop Test

| Measurement Points | First Measurement | Second Measurement |
|---|---|---|
| Battery negative post to battery negative cable end | | |
| Battery negative post to starter ground terminal | | |
| Battery negative post to frame ground | | |
| Battery negative post to master ground circuit breaker | | |
| Battery negative post to left-hand side dashboard ground terminal | | |
| Battery negative post to right-hand side dashboard ground terminal | | |
| Battery negative post to alternator ground (G) terminal | | |
| Battery negative post to engine left-hand side ground connection | | |

First measurement taken before cleaning
Second measurement taken after cleaning

### Battery Open Circuit Test/Load Test Results

Cold Cranking Amp (CCA) Rating of Batteries _____

| Open Circuit Voltage Test | | Battery Load Test | | |
|---|---|---|---|---|
| | Voltage | | Voltage | Amperage |
| Battery 1 | | Battery 1 | | |
| Battery 2 | | Battery 2 | | |
| Battery 3 | | Battery 3 | | |
| Battery 4 | | Battery 4 | | |

FormSB221032 (3/20/03)